



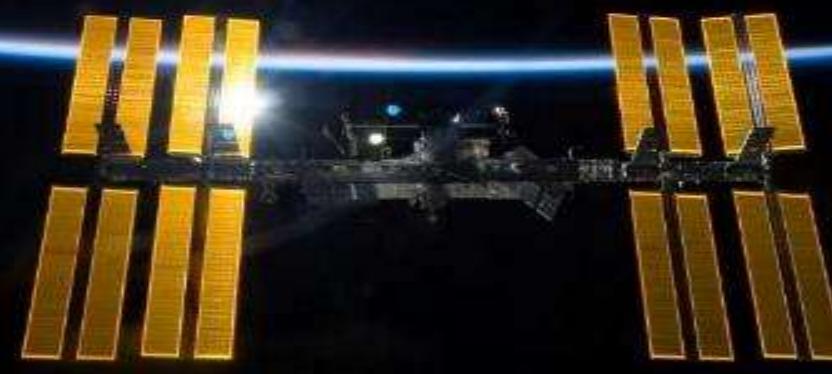
SPACEFLIGHT ASSOCIATED NEURO-OCULAR SYNDROME (SANS): 2023 Clinical Update



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SANS: 2023 Clinical Update

- SANS Prevalence
- On-orbit Diagnostic HW: Status
- New Diagnostic Thresholds
- Goggle-Based Visual Field (GBVF) device



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SANS Prevalence

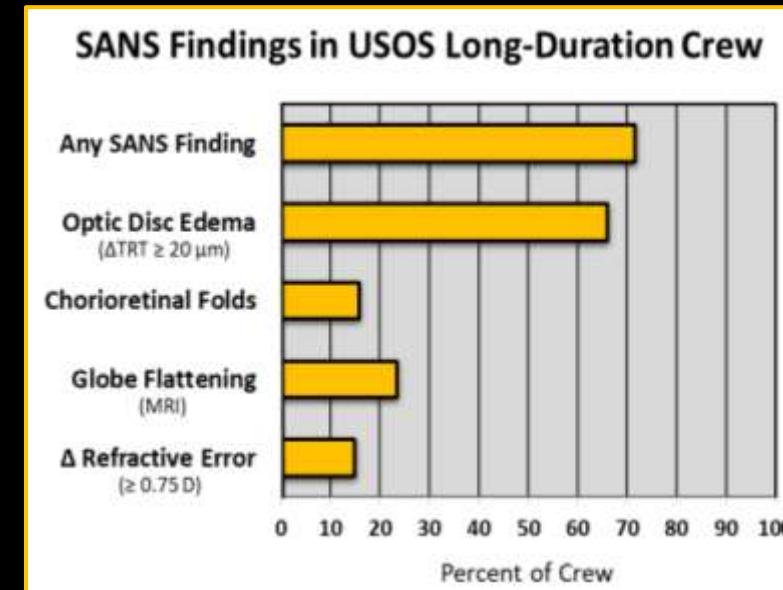
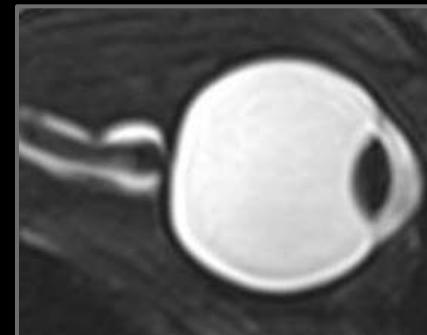
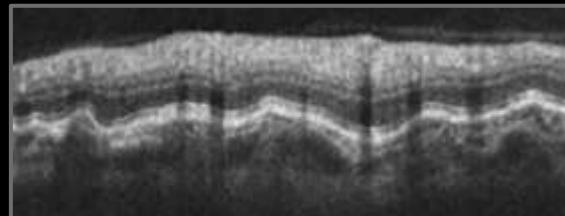




SANS Prevalence



- SANS: Unique to long-duration spaceflight (LDSF) w/ unclear pathogenesis & pathophysiology, and no perfect terrestrial analog
- **"Earliest Indication" of SANS detected in 72% of LDSF crewmembers** – When ≥ 1 of the following signs are detected in either/both eyes during or immediately following spaceflight:
 - Optic disc edema ($\geq 20 \mu\text{m}$ increase in peripapillary total retinal thickness [ΔTRT]) – 66%
 - Chorioretinal folds – 16%
 - Globe flattening (MRI) – 23%
 - Hyperopic shift in refractive error ($\geq 0.75 \text{ diopters}$) – 15%





On-orbit Diagnostic HW: Status





On-orbit SANS Diagnostic Hardware



Required On-orbit Tests	Associated HW	Status
Vision Screening	Acuity Pro (Acuity Pro, Inc.)	
Optical Coherence Tomography (OCT) & MultiColor Imaging	Spectralis OCT2 (Heidelberg Engineering)	
Fundoscopy (Color retinal photography)	Pictor Plus (Volk Optical)	
Ocular Ultrasound	Vivid q (GE HealthCare)	
Tonometry	Tono-Pen AVIA (Reichert)	
Threshold Visual Field	<i>Not yet available – ETA 2024</i>	





New Diagnostic Thresholds





New SANS Diagnostic Thresholds

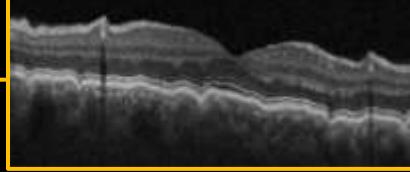


Feature of SANS	DIAGNOSTIC THRESHOLDS FOR SANS			
	<i>Earliest indication</i>	<i>Clinically Concerning</i>	<i>Pathological: Acute Functional Impact</i>	<i>Pathological: Affecting Long-Term Health</i>
OPTIC DISC EDEMA	$\geq +20 \mu\text{m}$ ΔTRT and/or evidence of mild edema not meeting Frisén grade 1	$\geq +55 \mu\text{m}$ ΔTRT and/or Frisén grade ≥ 1 <i>Note:</i> Post-flight lumbar puncture recommended	Visual field loss (e.g., enlarged blindspot) <i>Associated anatomical signs to be determined</i>	Permanent visual field loss and/or reduced retinal nerve fibre layer (RNFL) thickness
CHORIORETINAL FOLDS	Evidence of folds (choroidal or retinal) or peripapillary wrinkles	Sharp folds in vicinity of macula	Distorted central vision <i>Associated anatomical signs to be determined</i>	Permanently distorted central vision, atrophy of retinal pigment epithelium (RPE) or photoreceptors, and/or choroidal neovascularization
GLOBE FLATTENING	Evidence of posterior globe flattening (centered at optic nerve insertion) and/or decreased axial length (centered at fovea)	Moderate change	Shift in refractive error beyond power of available in-flight "Space Anticipation Glasses"	Currently unknown
REFRACTIVE ERROR SHIFT	$\geq +0.75$ dioptres	--		Currently unknown



New SANS Diagnostic Thresholds

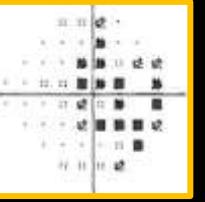
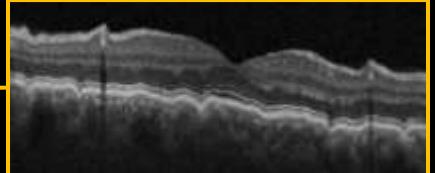
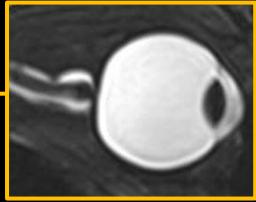


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New SANS Diagnostic Thresholds



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Goggle-Based Visual Field (GBVF) Device

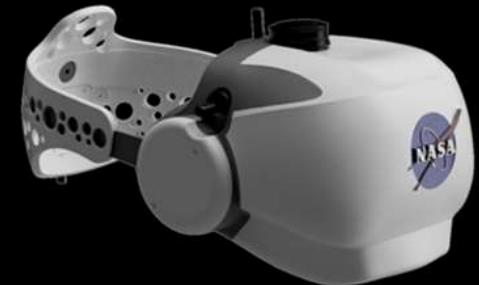




Goggle-Based Visual Field (GBVF) Device



- Being developed for extended-duration exploration missions (e.g., Mars)
 - 2018: Project initiated via NASA & TRISH funding
 - 2020-21: Three prototypes delivered
 - 2022: Ohio State University conducted clinical validation study
 - GBVF vs. Humphrey; 25 normal subjects, 25 w/ known VF defects
 - Devices showed similar capacity to detect defects/ normals
 - Subject preference: 36% - none; 44% - Humphrey; 20% - GBVF
 - Provided useful recommendations to further improve GBVF device hardware & software





Goggle-Based Visual Field (GBVF) Device



- Being developed for extended-duration exploration missions (e.g., Mars)
 - Nov 2022: Parabolic flight testing – 4 flights / 120 parabolas
 - Evaluated *human factors* (e.g., fit, ergonomics, comfort, light blockage, usability) and *basic functionality* of device in 0-g
 - Final report being generated, but preliminary results surpassed expectations
 - FY23/24: Perform GBVF modifications, per FY22 recommendations
 - FY24/25: ISS Tech Demo





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Thoughts? Questions?

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